

METHOD FOR INCREASING THE PERFORMANCE OF A
TRAFFIC SIGN RECOGNITION SYSTEM

[0001] The invention concerns a process for improving the performance of a system for recognizing and/or indicating traffic signs according to the precharacterizing portion of Patent Claims 1 and 10.

[0002] Documents DE 3619824 C2 and DE 198 52 631 A1 disclose processes and devices which recognize, classify and cause to be displayed traffic signs extracted from images of traffic scenes. Herein the processes analyze the image data provided by image sensors without any pre-recognition regarding the actual scenario. For this reason these known processes are time consuming and require a high computer capacity and performance in order to be able to process this data in real time.

Japanese document JP 06348991 discloses a system and a process for recognizing traffic signs, wherein the system employs a color camera and a therewith associated evaluation unit for image recognition. The invention is concerned with the task of, by evaluating the color information from the image information, automatically recognizing lane boundaries and devices for regulating traffic. Herein however there is no supplementation of the image information from the color camera with information from a map-based navigation system or a traffic information system for enhancing the recognition performance of the system.

New Patent Claims (PCT Substitute Page entered November 7, 2000):

1. Process for improving performance of a system for recognizing traffic signs, which includes a camera and a therewith associated evaluation unit for image recognition or for image display, thereby characterized, that the system utilizes information originating from at least one of a map-based navigation system or a traffic information system in the evaluation or display of contents of traffic signs.
2. Process according to Claim 1, thereby characterized, that the system is in communication with the map-based navigation system or the traffic information system via an onboard data bus.
3. Process according to Claim 1 or 2, thereby characterized, that the system for traffic sign recognition begins to operate at an enhanced performance when it is determined on the basis of map-based information that the vehicle is passing through area in which recognition of traffic signs may be problematic.
4. Process according to one of Claims 1 through 3, thereby characterized, that within problematic areas supplemental subdivided recognition processes are carried out, in such a manner that
- a) in the area of community entrances and community exits there is a specific search for signs indicating entry of a community and leaving of a community,
 - b) in the area of traffic influencing facilities, changing signs or traffic lights, separately attention is paid to a change in the type and manner of the representation of the traffic sign,
 - c) in an area, in which poor visibility due to fog or rain is present and a higher probability of contrast-poor images

must be calculated with, preferably an increase in the contrast enhancement of the image data is effected.

5. Process according to one of the preceding claims, thereby characterized, that the type or the position or the condition or the visibility or the size of a recognized traffic sign is stored in a data storage unit associated with the map-based navigation system or the traffic information system.

6. Process according to one of the preceding claims, thereby characterized, that the type or the position or the condition or the visibility or the size of a recognized traffic sign is stored in a data storage unit associated with the system for recognition of traffic signs.

7. Process according to one of Claims 5 or 6, thereby characterized, that by means of a signal producer contained in the display unit, an acoustic or optical signal is emitted when, along an already traveled road segment, a change with respect to the position or a change as to the presence or absence of a traffic sign occurs.

8. Process according to one of the preceding claims, thereby characterized, that starting at the map-based navigation system or the traffic information system, a program for application of a decision logic is controlled in such a manner, that the image of the traffic sign is displayed for such a period, until a predetermined traveled path stored in the storage unit is traveled, which is preferably class specific.

9. Process according to Claim 8, thereby characterized, that the predetermined traveled paths are programmed into a data storage unit.

10. Process according to one of the preceding claims, thereby characterized, that the system for recognition of traffic signs, during the processing of image data provided by an image sensor, examines these for the presence of traffic signs, then extracts these, separates these into upper and lower classes and in association therewith extracts class-specific characterizing data, which are then supplied to a separate classification.

11. Process according to Claim 10, thereby characterized, that the classification occurs hierarchically, in multiple classification steps.

12. Process according to Claim 11, thereby characterized, that the classification steps are essentially set up follows:

- a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,
 - aa) upon successful classification, wherein the class could be recognized correctly with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,
 - ab) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,
- b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,
 - ba) upon successful classification, wherein the class could be recognized with a high degree of confidence,

the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the lower class are substituted by the original image data from the image sensor.

13. Device for enhancing the performance of a system for recognizing or displaying traffic signs, which includes a camera and a therewith associated evaluation unit for image recognition or for image display, thereby characterized, that the system is associated with at least one of a map-based navigation system or a traffic information system, in order to utilize information originating therefrom in the recognition and/or the display of contents of traffic signs.

14. Device according to Claim 13, thereby characterized, that a connection is made via an onboard data bus between the system, the map-based navigation system and/or the vehicle traffic information system is.

15. Device according to Claim 13 or 14, thereby characterized, that the system for traffic sign recognition has the capacity to work with heightened performance when, on the basis of map-based information, it is determined that the vehicle is passing through an area in which the recognition of traffic signs may be problematic.

16. Device according to one of the preceding claims, thereby characterized, that the map-based navigation system or, as the case may be, the traffic information system, is provided with a data storage unit, in which at least one of the type, the

position, the condition, the visibility and the size of the recognized traffic sign is stored.

17. Device according to one of the preceding claims, thereby characterized, that the system for recognizing of traffic signs is provided with a data storage unit, in which at least one of the type, the position, the condition, the visibility and the size of the recognized traffic sign is stored.

18. Device according to one of Claims 16 or 17, thereby characterized, that the display unit includes a signal emitter which emits an acoustic or optical signal when along an already traveled road segment a change occurs with respect to the position or the presence or absence of a traffic sign.

19. Device according to one of the preceding claims, thereby characterized, that a program for utilization of a decision logic is provided in the system, which displays the image of a traffic sign until a predetermined path length, based upon the map-based navigation system or the traffic information system, has been traveled, which is preferably class specific.

20. Device according to Claim 16, thereby characterized, that a memory unit is provided in the system, in which the predetermined path lengths are stored and via which they are made available for processing.

21. Device according to one of the preceding claims, thereby characterized, that a processing unit is provided in the system for recognition of traffic signs, which processing unit examines image data supplied by an image sensor for the presence of traffic signs, then extracts these data, separates these into upper and lower classes and in this context extracts class

specific characterizing data and separately supplies these to a classifier.

22. Device according to Claim 21, thereby characterized, that this classifier is constructed hierarchically, in multiple classification steps.

23. Device according to Claim 22, thereby characterized, that the classification steps are so constructed, that the classifier accomplishes the following functionalities:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification, wherein the class could be recognized correctly with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification, wherein the class could be recognized with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the lower class are substituted by the original image data from the image sensor.

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